Strategic Implementation Plan (SIP) for a Community-based Unified Modeling System

System Architecture Working Group

Presented by

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System Architecture WG *Membership*

Member	Affiliation	Member	Affiliation
Cecelia DeLuca (co-chair)	NOAA ESRL	**Jim Kinter (co-chair)**	COLA/GMU
Tom Auligne	JCSDA	Mark Iredell	NOAA NCEP
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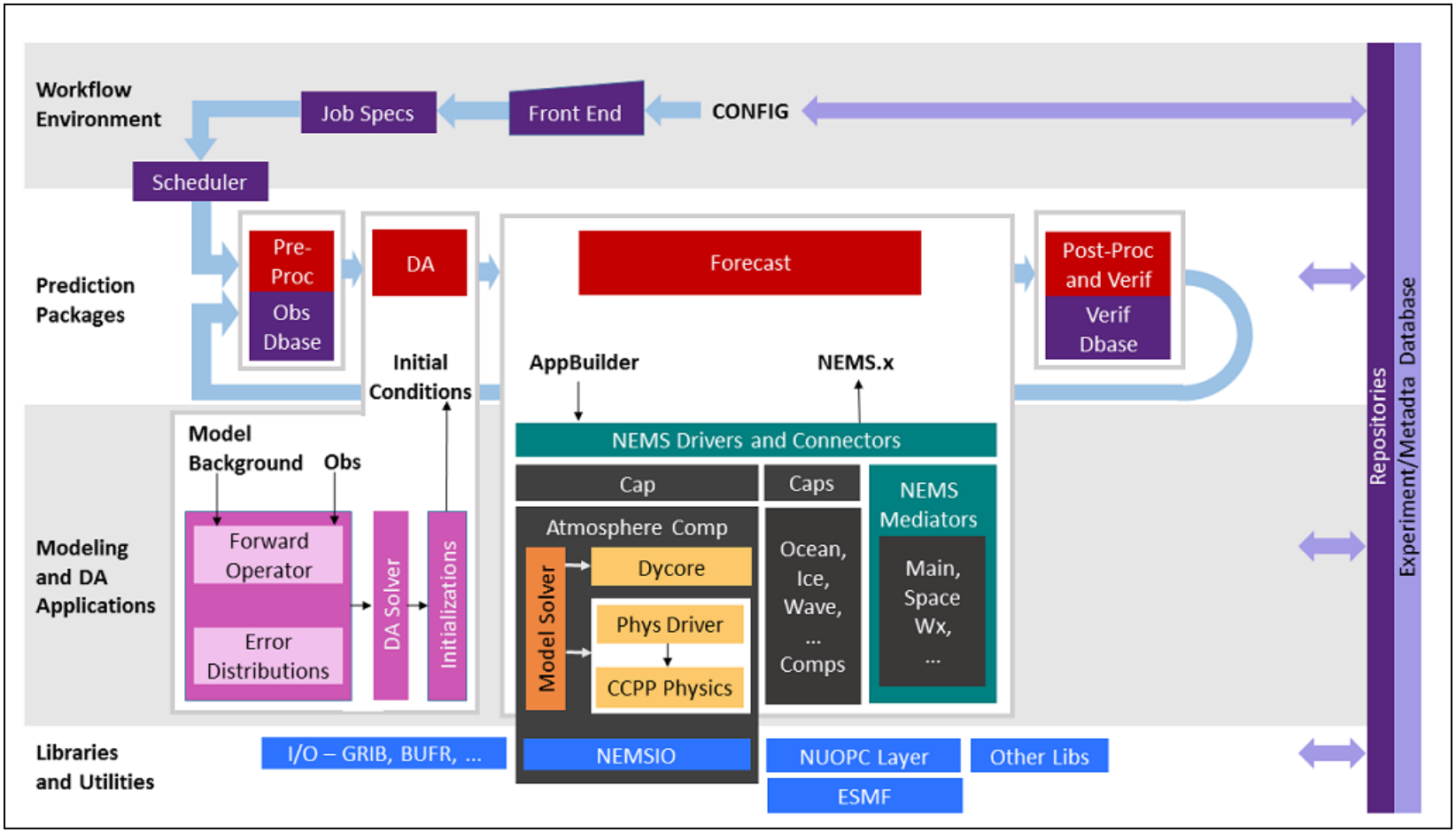
Michael Farrar (ex officio)	NOAA NCEP	50% NOAA; 50% external	

SAWG initiated in October 2016
SAWG website: https://esgf.esrl.noaa.gov/projects/sawg/
Initial SAWG report: https://esgf.esrl.noaa.gov/site_media/projects/sawg/System_Architecture_31Mar2017.pdf

System Architecture WG
Definition and Relevance

- **Definition:** Fundamental organization of a system
  - Components
  - Relationships among components and the environment
  - Principles that govern its design and evolution
- **Relevance for operational prediction**
  - Backbone of a unified modeling system
  - High-performance, reliable, technical and scientific functions for a range of different forecast products
- **Relevance for research community partners**
  - Facilitates experimentation
  - Facilitates participation as full partners in model development

System Architecture
Layers and Elements



From *NEMS System Architecture Description*, result of the NEMS Code, Data, and Documentation Management Workshop Sept. 1-2, 2016, College Park, MD: https://esgf.esrl.noaa.gov/projects/nems-workshop/

System Architecture WG
Initial Findings

General Recommendations

- **Meet the needs of stakeholders**
- **Be cost effective and timely**
- **Enable acknowledging, managing, and mitigating risks**
- **Be implemented using modern software engineering practices**
- **Be interoperable with coupling architectures at U.S. partner institutions**

Technical Recommendations

- **Document requirements for coupling, outputs, ensembles and data assimilation, workflows, and the interface between atmospheric dynamics and physics**
- **Support diagnostic interrogation of model output for testing, model evaluation, and operational prediction quality assessment**
- **Enable high scalability on current and emerging large, high-performance computer systems**

System Architecture WG
Initial Findings

Structural Recommendations

- **Implement a layered design with clear interfaces that supports deployment of modeling and data assimilation applications at multiple organizations**
- **Link to governance processes that support the unified modeling system**
  - Limit divergence of independent development paths
  - Authorize requirements and milestones
  - Review requirements, code, and processes for obsolescence
- **Balance independence with coordination**
  - Application development groups have their own requirements and timelines but need to share components and infrastructure as part of a unified modeling system

Modeling Application Recommendations

- **Evidence included in initial report**
  - Gap analysis (management, unified modeling, ESMF/NUOPC)
  - Sources of requirements
  - Interoperability case studies

System Architecture WG
Initial Findings

Modeling Application Recommendations (cont.)

- **Explore feasibility of replicating an existing science approach (e.g. GFDL) using NEMS, with test problems and metrics**
  - leverage community interoperability infrastructure and expertise in coupled modeling
  - identify significant differences in framework capabilities
  - assess interchangeability of NEMS and non-NEMS components
- **Establish new leads and processes (links to Governance WG)**
  - Standing science lead or steering committee responsible for direction of overall NOAA unified modeling system
  - Formal processes that allow for external participation in technical and scientific decision-making
  - Modeling system lead at EMC to serve as the primary POC and coordinator for coupling science and technology
- **Partner with CESM and others in the community**
  - Engage coupled system science contributors from the broader community
  - Develop community-friendly infrastructure
  - Leverage established outreach and training programs in coupled modeling
- **Understand best practices and restructure legacy scripts**

System Architecture WG
Key Issues to Resolve

- **Relationships among other aspects of system architecture and applications**
  - Data assimilation and ensemble applications
  - Physics interface, including aerosols/chemistry
  - Workflow layer
  - Libraries and utilities layer
- **Resolution of modeling application strategy following activities and tests**
- **Critically important governance issues to be resolved with the SIP Governance WG**
  - Need for steering body responsible for overall unified modeling system
  - Need for a way to process and implement recommendations
  - Need for integrated and authorized requirements and milestones
- **Software process issues to be resolved with the SIP Infrastructure WG**
  - Need for modeling lead and software management
  - Need for development coordination across application teams
  - Strategies needed for community engagement in software processes
- **Balancing demands on computing and human resources**